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Description

ARTICLE-ORIENTING CONVEYOR

Background of Invention

[0001] The invention relates generally to power-driven conveyors and, more particularly, to an orientation and registration conveyor using a roller-top conveyor belt.

[0002] Many conveying applications require that conveyed articles be aligned single file in a specific orientation for downstream processing or inspection. But it is often not possible to ensure that articles will be placed on a conveyor in the desired alignment and orientation. Consequently, there is a need for a conveyor that can align and orient conveyed articles in spite of their original orientations on the conveyor.

Summary of Invention

[0003] This need and other needs are satisfied by a conveyor embodying features of the invention. In one aspect, the conveyor comprises a first conveyor belt and a second belt. The first conveyor belt runs along a conveying path

at a first velocity in a conveyance direction. The first conveyor belt extends transverse to the conveyance direction from a first side to a second side. The first conveyor belt includes a plurality of article-supporting rollers arranged to direct supported articles toward the first side as the first conveyor belt runs in the conveyance direction. The second belt is disposed proximate the second side of the first conveyor belt. The second belt runs at a second velocity parallel to the first conveyor belt. The first velocity (of the first conveyor belt) in the conveyance direction exceeds the second velocity (of the second belt) in the conveyance direction. The difference between the velocities causes articles on the first conveyor belt extending past its second side and into contact with the second belt to rotate.

[0004] In another aspect of the invention, a conveyor for orienting and registering conveyed articles comprises a conveyor belt with article-supporting rollers. The conveyor belt advances along a conveying path in a conveyance direction from an upstream end to a downstream end. The conveyor belt extends transversely from a first side to a second side. The article-supporting rollers are arranged to direct supported articles toward the first side of the

conveyor belt. The conveyor also includes a registration surface disposed at the first side of the conveyor belt at its downstream end against which articles are registered. Orientation means proximate to the second side of the conveyor engage those portions of conveyed articles that extend outward from the conveyor belt past its second side. The orientation means impedes the progress of the extending portions of the conveyed articles, thereby causing the extending portion to move onto the conveyor belt in a different orientation from the article's original orientation.

[0005] In yet another aspect of the invention, a conveyor for orienting and registering a conveyed article comprises an angled-roller-top conveyor belt and an orientation belt. The angled-roller-top conveyor belt runs at a first speed in a conveyance direction along a conveying path. Article-supporting rollers on the conveyor belt are arranged to rotate about axes oblique to the conveyance direction. The conveyor includes a registration surface parallel to the conveyance direction at a first side of the angled-roller-top conveyor belt. The orientation belt is disposed at the second side of the angled-roller-top belt. The orientation belt runs at a second speed that is opposite the

conveyance direction or, if in the conveyance direction, that is slower than the first speed so that there is relative motion between the two belts in the conveyance direction. The orientation belt engages a conveyed article extending past the second side of the angled-roller-top conveyor belt. The relative motion of the two belts causes the conveyed article engaged by the orientation belt to rotate clockwise toward an alignment of the article with the conveyance direction. As the article is being oriented, the angled-roller-top belt guides it toward and along the registration surface.

Brief Description of Drawings

[0006] These and other features, aspects, and advantages of the invention are better understood by reference to the following description, appended claims, and accompanying drawings, in which:

[0007] FIG. 1 is an isometric view of one version of an article-orienting conveyor embodying features of the invention, including a flighted orientation belt;

[0008] FIG. 2 is a front elevation view of one version of a drive system at one end of a conveyor as in FIG. 1;

[0009] FIG. 3 is a cross-sectional view of a portion of the roller-top belt of FIG. 1 taken along line III-III of FIG. 1;

[0010] FIG. 4 is a top plan view of the conveyor of FIG. 1;

[0011] FIG. 5 is an isometric view of another version of article-orienting conveyor in which the orientation belt is a friction-top belt;

[0012] FIG. 6 is top plan view of another version of article-orienting conveyor embodying features of the invention including a flighted orientation belt running in a plane perpendicular to the plane of a conveyor belt;

[0013] FIG. 7 is a top plan view of a another article-orienting conveyor embodying features of the invention including a paddle wheel to orient conveyed articles; and

[0014] FIG. 8 is an isometric view of yet another version of article-orienting conveyor embodying features of the invention including spaced-apart stationary posts to orient conveyed articles.

DETAILED DESCRIPTION

[0015] An orientation and registration conveyor embodying features of the invention is shown in FIG. 1. The conveyor 10 includes two belts: a conveyor belt 12 and an orientation belt 14. The substantially coplanar belts are looped between a pair of shafts 16, 17. One of the shafts 16 serves as a drive shaft for the conveyor belt 12 and includes a set

of toothed drive sprockets 18 mounted on the shaft, as shown in FIG. 4. The drive shaft for the conveyor belt also includes a set of idler rollers 20 around which the orientation belt 14 slides. The shaft 16 is supported at its ends by bearing blocks 22 mounted to a conveyor frame (not shown for simplicity). A first drive motor 24 coupled to the shaft 16 drives the conveyor belt 12 in a conveyance direction 26. The other shaft 17 serves as a drive shaft for the orientation belt 14. Toothed drive sprockets 19 for the orientation belt are mounted on the shaft to drivingly engage drive structure on the inner side of the orientation belt. Idler rollers (not shown) are also mounted on the shaft 17. The conveyor belt slides around the idler rollers as it is driven by its drive sprockets 18 on the other shaft 16. A motor 25 drives the shaft 17. The motor can be reversible to drive the orientation belt in either direction 27, but preferably drives the orientation belt only in the direction opposite to the conveyance direction 26.

[0016] The conveyor belt 12 is preferably an angled-roller-top belt in that it includes a plurality of rollers 28 that are arranged to rotate about axes 30 oblique to the conveyance direction 26. A salient portion of the rollers protrudes above the top side of the belt to support articles 34

placed on the belt. As shown in FIG. 5, the rollers also protrude through the bottom side of the belt into contact with supporting wearstrips 36 that provide bearing surfaces on which the rollers rotate as the belt advances in the conveyance direction. The wearstrips are supported on a carryway pan 37. The rollers are preferably generally cylindrical in shape with a central bore admitting an axle 38 that defines the axis of rotation. The ends of the axle are preferably retained in the interior structure of the belt. The drive sprockets 18 drive against drive surfaces 39 formed periodically along the bottom side of the belt.

[0017] A preferred conveyor belt is a modular plastic conveyor belt constructed in a bricklay pattern out of a plurality of individual plastic belt modules, including right edge modules 40, interior modules 41, and left edge modules 42. The modules are arranged in rows interconnected by hinge pins into an endless belt loop. The modules are preferably injection molded out of thermoplastic materials such as polypropylene, polyethylene, acetal, nylon, or composite resins that may include fibers or other additives. The rollers may be molded out of similar materials or co-molded out of two materials such as a durable nylon core around the bore with a high-friction outer layer

made of rubber or a rubber-like material for good engagement with the wearstrip or the conveyed articles. The axle is preferably made of a strong material, such as stainless steel.

[0018] The orientation belt 14 shown in FIG. 1 is also preferably a modular plastic conveyor belt that includes upstanding flights 44. The base of the belt is preferably molded out of one of the same thermoplastics as the conveyor belt. The flight is preferably unitarily formed with the base out of the same material or out of a more resilient elastomer or rubber-like material to prevent it from scratching conveyed articles it contacts.

[0019] A side rail 46 is positioned along the left side edge of the conveyor belt. Although the side rail is shown in the drawings parallel to the conveyance direction, it could alternatively be disposed at an angle or curved relative to the conveyance direction and the left side edge of the belt. The side rail includes a plurality of rollers 48 arranged to rotate about vertical axes. The rail registers conveyed articles at the edge of the belt, and the rollers prevent the registered articles from being scuffed as they slide along the rail. If scuffing or friction along the rail is not critical, rollers in the side rail are not needed. The side

rail could be realized as a length of roller-top conveyor belt, such as the INTRALOX Series 400 ROLLER TOP belt manufactured and sold by Intralox, Inc. of Harahan, Louisiana, USA.

[0020] When an article 34 is introduced onto the conveyor belt 12 at its upstream end 50, as best shown in FIG. 4, the article is transported by the conveyor belt in the conveyance direction 26 toward its downstream end 51 to a processing station 52, such as a security scanning device. The processing station may include its own conveyor 53 enclosed in a housing 55 with an aperture 57 through which the articles pass. To insure that no articles get hung up at the aperture, the spacing S between the side rail and the inside edge of the flights 44 is selected to be no wider than the width of the aperture. If an article is oriented on the conveyor belt 12 such that it would not be able to fit through the aperture in that orientation, the article will extend from the side of the conveyor belt onto the orientation belt 14, which is preferably driven in the opposite direction 27'. When the portion of the conveyed article extending past the conveyor belt is struck by a flight 44 on the orientation belt, the flight causes the article to rotate clockwise 54 so that it starts to align with the conveyance

direction. As the article is conveyed along the carryway, the angled rollers 28, which are rotating as they roll along the bearing surfaces of the supporting wearstrip, provide a sidewise component of motion 56 to the articles toward the rail 46. Eventually, the articles are oriented so as to fit through the aperture without jamming. The side rail provides a registration surface 58 to the articles along the side edge of the belt. The registration surface, though shown parallel to the conveyance direction, could alternatively be angled or curved inward or outward from the side edge of the belt.

[0021] Although it is preferable that the orientation belt be driven in the opposite direction from the conveyor belt, it is critical only that the velocity of the conveyor belt exceed the velocity of the orientation belt in the conveyance direction. Under that condition, the relative speed of the conveyor belt in the conveyance direction is greater than the speed of the orientation belt in the conveyance direction. As long as the motion of the orientation belt is retarded relative to the motion of the conveyor belt in the conveyance direction, the flights will be effective in causing articles extending past the conveyor belt onto the orientation belt to rotate clockwise toward alignment.

[0022] The flighted orientation belt 14 of FIGS. 1 and 4 is replaced by a friction-top belt 60 in another version of the alignment conveyor illustrated in FIG. 5. In this version, the outer surface 62 of the orientation belt is topped with a high-friction material, such as rubber or a rubber-like elastomer. The friction between the rubber surface and articles conveyed on the conveyor belt must be great enough to cause the articles extending past the conveyor belt onto the orientation belt to rotate clockwise as long as the conveyor belt is moving at a greater speed than the orientation belt in the conveyance direction 26. In all other respects, this friction-top orientation means operates the same as the flighted orientation means in the article-orienting conveyor.

[0023] Still another version of orientation belt is shown in FIG. 6. In this version of article-orienting conveyor, the orientation belt is a flighted belt 70 running in a plane generally perpendicular to the plane of the conveyor belt 12. The orientation belt loops around sprockets 71 on shafts 72, 73 perpendicular to the shafts 16, 17 of the conveyor belt. The distal ends 74 of the spaced apart flights 76 extending outward from the surface of the perpendicular orientation belt run along the right side edge of the conveyor

belt. Like the other orientation belts, the perpendicular orientation belt is driven in the direction 78 opposite to the conveyance direction 26 or, if in the same direction, at a speed slower than the speed of the conveyor belt. The flights engage articles 34 extending past the right side edge of the conveyor and rotate them toward the preferred orientation. Of course, the orientation belt could be arranged at an angle relative to or even perpendicular to the orientation belt shown in FIG. 6, as long as the flights have a component of motion at the right side edge of the conveyor belt that is opposite to or retarded in speed relative to the speed of the conveyor belt in the conveyance direction.

[0024] FIG. 7 shows another orientation means in an article-orienting conveyor. In this version, the orientation belts of FIGS. 1 and 5 are replaced by a paddle wheel 80 that rotates on a vertical shaft 82. Paddles 84 extending outward from the periphery of the wheel serve the same purpose as the flights of the orientation belts of FIGS. 1 and 5, which strike articles extending past the side of the conveyor belt and cause them to rotate into alignment.

[0025] Yet another orientation means in an article-orienting conveyor is shown in FIG. 8. In this version, the orientation

belts of FIGS. 1 and 5 are replaced by a stationary platform 64 with upstanding obstructions in the form of posts 66. Although the posts are arranged parallel to the conveyance direction, they could be arranged at an angle relative to the conveyance direction. Because the platform and its posts are stationary, the forward motion of the conveyor belt 12 in the conveyance direction defines the relative motion between the conveyor belt and the stationary orientation means. Articles extending past the right side of the conveyor belt strike the posts, which cause the articles to rotate clockwise toward the preferred alignment position as they register against the side rail 46 as urged by the rotating rollers 28 of the conveyor belt. Because an orientation belt is not used, this conveyor needs one less drive motor and one less set of drive sprockets and of idler sprockets than the other versions.

[0026] Thus, the invention provides a conveyor that can orient articles in the preferred orientation and register them in a preferred position for downstream processing, such as at a security scanning station. The effectiveness of airport baggage security operations is increased by uniformly orienting the bags to be scanned by a scanning device with their major axes perpendicular to the scanner view. This

orientation generally results in a greater viewing area with less occlusion of objects contained in the bags.

[0027] Although the invention has been described in detail with respect to a few preferred versions, other versions are possible. As one example, the bearing surfaces for the conveyor belt rollers do not have to be individual linear wearstrips. They could alternatively be a continuous conveyor pan extending transversely across the width of the conveyor belt along the carryway or an arrangement of static or dynamic rollers that contact the rollers of the conveyor belt. As another example, various orientation means were described, but others are possible. For instance, upstanding obstructions of other shapes besides flights or posts could be used effectively, including a continuous surface. Likewise, frictional surfaces other than rubber, such as ridged, dimpled, or rough-textured, could be used to contact extending portions of conveyed articles. As a further example, a conventional rollerless side rail could be used to register the articles. So, as these few examples suggest, the scope of the invention is not to be limited to the versions described in detail.

[0028] What is claimed is: